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Grand Rounds Series

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Center for Public Health Preparedness

For more information please contact us at 518-486-7921 or email:
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Assessing Chemical Exposure: A Different Approach

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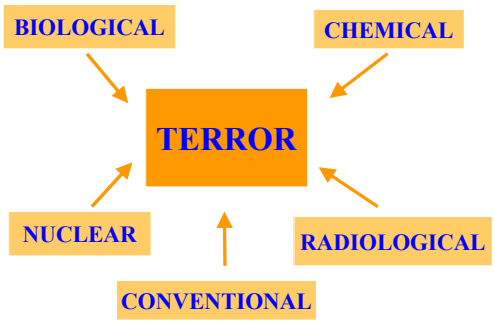
Wadsworth Center

Three Broad Topics

- Introduction to Chemical Terrorism
- Toxicology/Properties of likely agents
- Public Health/Laboratory response



Toxic Industrial Chemicals

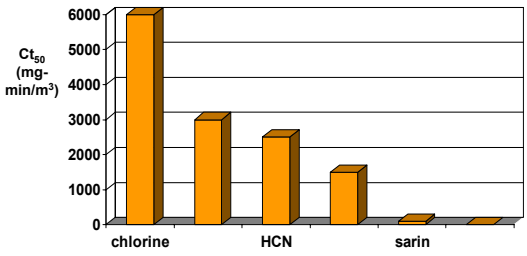
- Chlorine
- Hydrogen Cyanide
- Ammonia
- Phosgene
- Methyl Isocyanate

Bhopal, India

December 3, 1984

- 40 Tons of MIC (methyl isocvanate)
- 500,000 exposed (5-8 miles downwind)
- 11,000 disabled
- 3,800 dead

Comparative Toxicity (lethal dose)



Highly Toxic Agents Developed to Kill or Disable

Advantages:
- Small amounts needed
- Surreptitious use
- Targeted use

Disadvantages:
- "Harder" to obtain
- Nations?
- Cults?
- Lunatics?

Recent Terrorist Incidents with Organophosphorus Nerve Agents

- 1994 Matsumoto Japan
  7 killed; 150 injured
- 1995 Tokyo Japan
  12 killed; 5000 injured;
  Aum Shinrikyo cult
- Cult opponent murdered by injection of VX

Some Overt Exposure Scenarios

- Blast, leak
- Ventilation ducts
- Closed spaces:
  - subway cars
  - planes
- Vehicular releases:
  - drive-by
  - crop dusting

Some Covert Exposure Scenarios

- Food, tobacco, alcohol
- Medications, blood products
- Cosmetics and personal hygiene products
- Surfaces (door knobs, utensils): hand-to-mouth
- Fixed distribution systems: water, natural gas

Respiratory Irritant Gases

- Chlorine
- Phosgene
- Oxides of nitrogen
- Ammonia
- Hydrogen chloride
- Formaldehyde
- Acrolein

Respiratory Irritant Gases

- Direct chemical reaction with tissues
  - pH, redox, addition, substitution reactions
    - structural lipids and proteins denatured or degraded
  - Induced inflammatory reaction

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Metabolic Toxicants

- Cyanides
- Azides
- Sulfides
- Carbon monoxide
- Fluoroacetates
- Dinitrophenol, pentachlorophenol
- Many others

CDC

Cyanide: Toxicological Mode of Action

- Blocks electron transport in mitochondria
  - Binds to Fe^{+3} in cytochrome oxidase
  - Prevents electron transfer to oxygen
    - Oxygen-rich red venous blood

Carbon Monoxide

- #1 chemical cause of acute toxic death
- #2 rank air pollutant after CO_2
  - Vehicular, coal/oil burning, industrial
- Invisible, odorless
- Affinity for Hgb 220x greater than that of O_2
  - Forms carboxyhemoglobin
  - Proportionately decreases oxygen carrying capacity
  - Red venous blood

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Vesicant Agents (Blister Agents)

- Mustard agents
  - Sulfur (military use)
  - Nitrogen (chemotherapy)
- Lewisite
  (2-chlorovinyl dichloroarsine)

Mustard: Targets

- Reacts with molecules in skin cells within a few minutes
  - Rapid decontamination is essential: water
  - Onset: 2 to 48 hours

Acute & prolonged:	Systemic & delayed:
Eyes	Bone marrow
Airways	GI tract
Skin	Lymphoid tissue

Nerve Agents

- A family of agents that kill by destroying acetyl cholinesterase, an enzyme essential for proper nerve function

Physical Properties

- Liquids at room temperature - not gases
- Soluble in fat and water
  - Absorbed through respiratory tract, skin, eyes
- Phosphonate esters
  - Tabun (GA) - most unavailable
  - Sarin (GB) - most volatile
  - Soman (GD) - fastest "aging"
  - VX - most potent and persistent
- Other nerve agents

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Symptoms of Nerve Agents

"DUMBELS"

- D - Diarrhea
- U - Urination
- M - Miosis
- B - Bronchoconstriction, Bronchorrhea
- E - Emesis
- L - Lacrimation
- S - Salivation

CDC Public Health Aims
in a Chemical Event

- Identify the agent or cause
  - Circumstance, intelligence, clinical syndrome
  - Environmental or biological fluids assay
- Determine temporal or geographical distribution of exposure
- Determine relative (high/low) exposures

(cont.)

CDC Public Health Aims
in a Chemical Event (cont.)

- Evaluate health implications
- Provide medical and public health guidance and support
- Provide continued surveillance and prevention

After a CT Incident Environmental Samples:

- Identify chemical agent on scene
- Define contamination zone
- Check for effective decontamination
- Determine when to allow re-entry

After a CT Incident Clinical Samples:

- Confirm agent ID
- Assist in medical treatment
- Separate exposed from "Worried Well"
- Support health effect studies

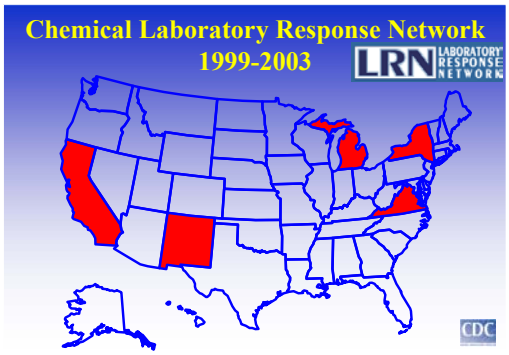
Predicting levels of toxicants in people using environmental monitoring is very difficult and includes many assumptions…

Biomonitoring- Measuring Chemicals in People

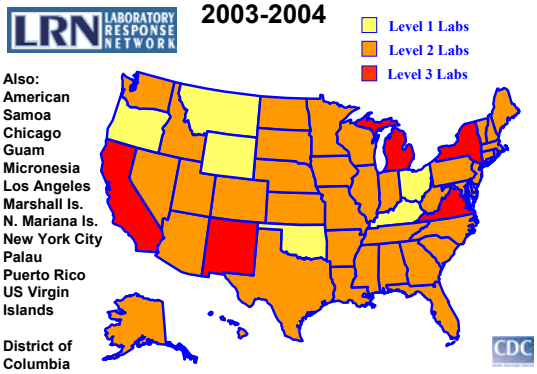
- CDC advocates for and supports biomonitoring as a tool to assess human exposure to toxic chemicals

CDC and CT

- CDC's chem lab role in federal disaster response and environmental health investigation is analysis of HUMAN specimens
- In 1999, CDC competitively awarded 5 grants to develop state capacity to measure CW agents in human specimens



Chemical Laboratory Response Network 2003-2004



CDC's Plan for Human Specimens

- Local HAZMAT/first responders identify or suspect incident
- Jurisdiction or FBI notifies CDC
- Labs collect and ship initial samples to CDC
- CDC performs PCR and "Rapid Toxic Screen" on initial samples
- CDC provides guidance to LRN for analysis of remaining samples

Rapid Toxic Screen

- Analysis of 40 samples for 150 agents or metabolites within 36 hrs
- CDC has greater "screening" capability than currently available at any city or state public health lab

Collecting Clinical Specimens:

- Protocols for collecting and shipping blood and urine are posted on NYSDOH's secure website and on CDC's website:

http://www.bt.cdc.gov/labissues/pdf/chemspecimencollection.pdf

cont

Collecting Clinical Specimens:

- Clinical specimens will be collected at hospitals
- NYSDOH will continue training hospital staff on these procedures

Environmental Samples cont.

- Environmental samples (air, water, wipes) may be collected near or in "hot" zone
- Staff within hot zone must use Level A protective equipment

Environmental Samples cont.

- Wadsworth's standard procedures for collecting these sample types will soon be posted on the NYSDOH secure website
- These procedures may need modification to accommodate Level A suit constraints

Call Wadsworth Before Submitting Any "CHEM"Samples!

NYSDOH Phone Numbers

Wadsworth - 518-474-7161

BTSA - 518-402-7800

After Hours - 1-866-881-2809

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